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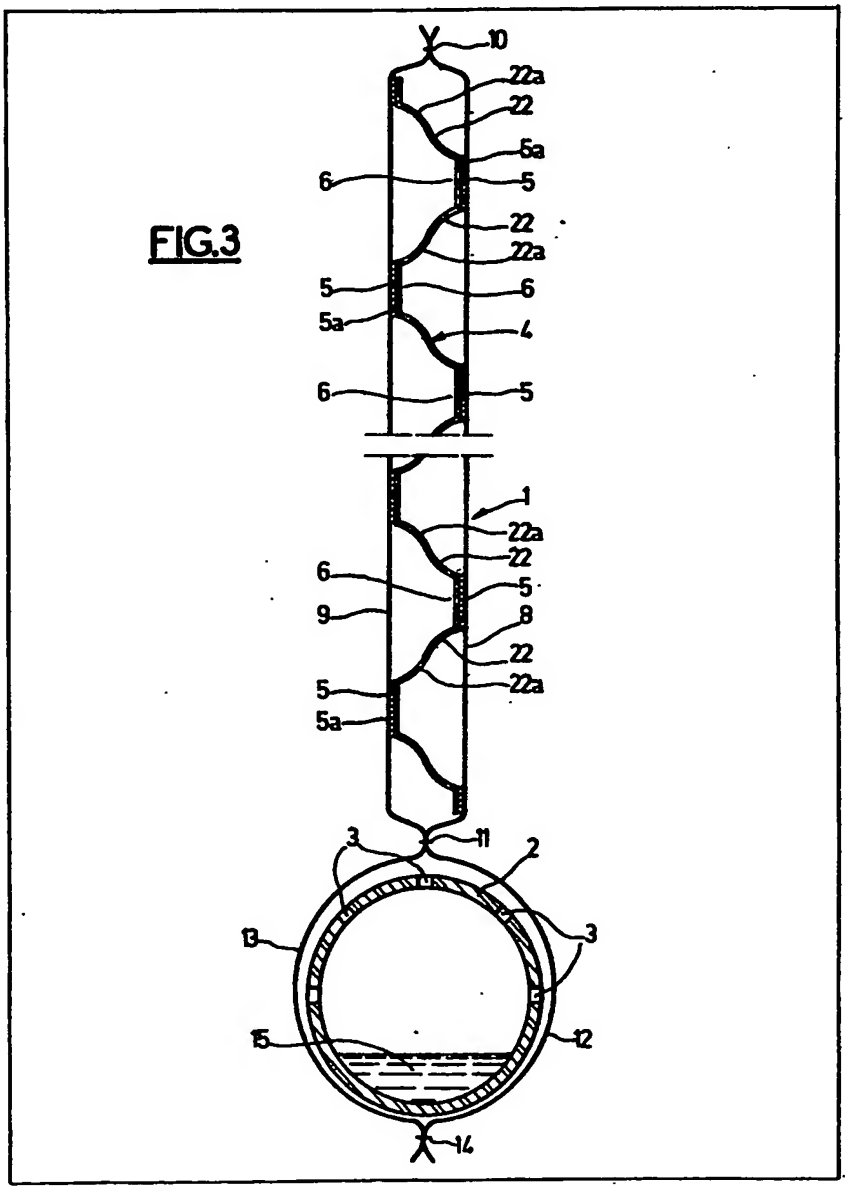
(71) Applicants Cofrad, 62 Rue de Gisors 95300, Pontoise, France
(72) Inventors Joseph Glaeser, Francois Lede
(74) Agents Forrester, Ketley & Co., Forrester House, 52 Bounds Green Road, London N11 2EY

(54) **Improvements in or relating to a drain**

(57) A drainage device comprises an inner core 4 formed with a number of projections 5 and corresponding recesses 6 having flat apexes or tops and disposed in staggered rows, to define non-linear drainage channels between the core and two non-woven filter sheets 8, 9 which are mounted adjacent the two surfaces of core 4. A drain pipe 2 is inserted between two extending edge portions 12, 13 of the filter sheets 8 and 9. The drainage device, when disposed underground, can thus collect underground water, which is suitably filtered by sheets 8, 9 and flows through the channels adjacent core 4 so as to be discharged through pipe 2.

FIG.3



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1

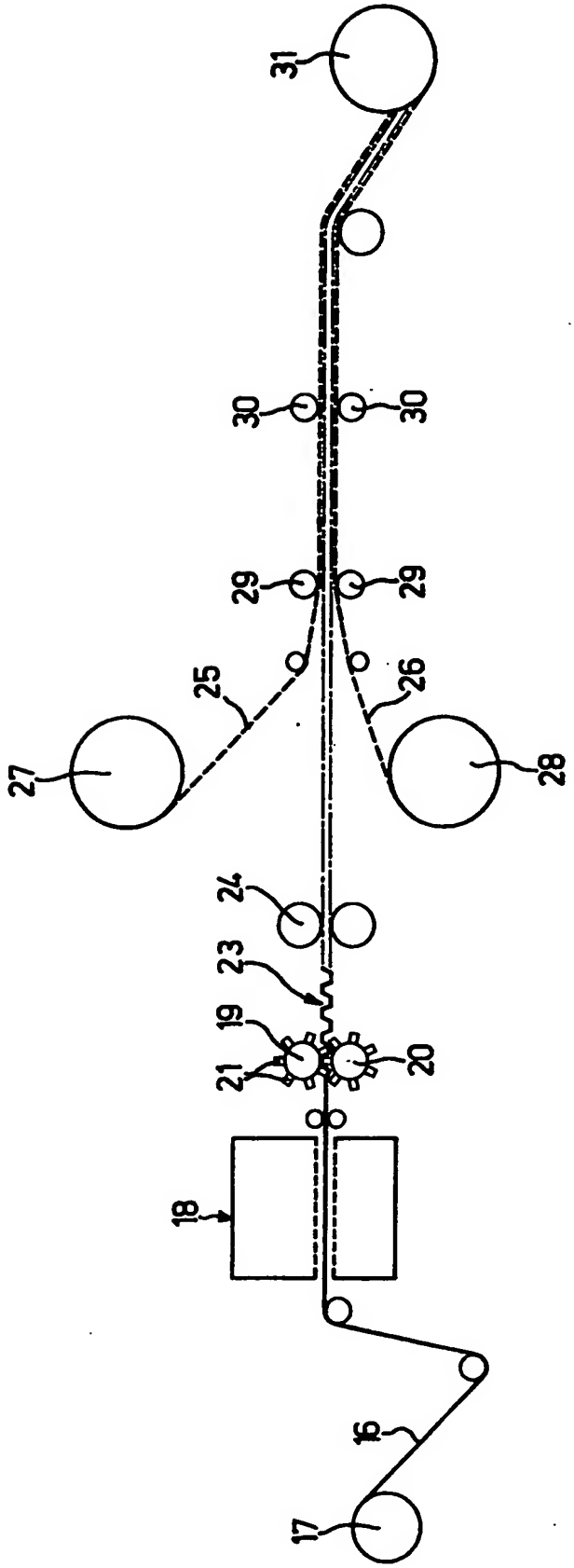

FIG.2

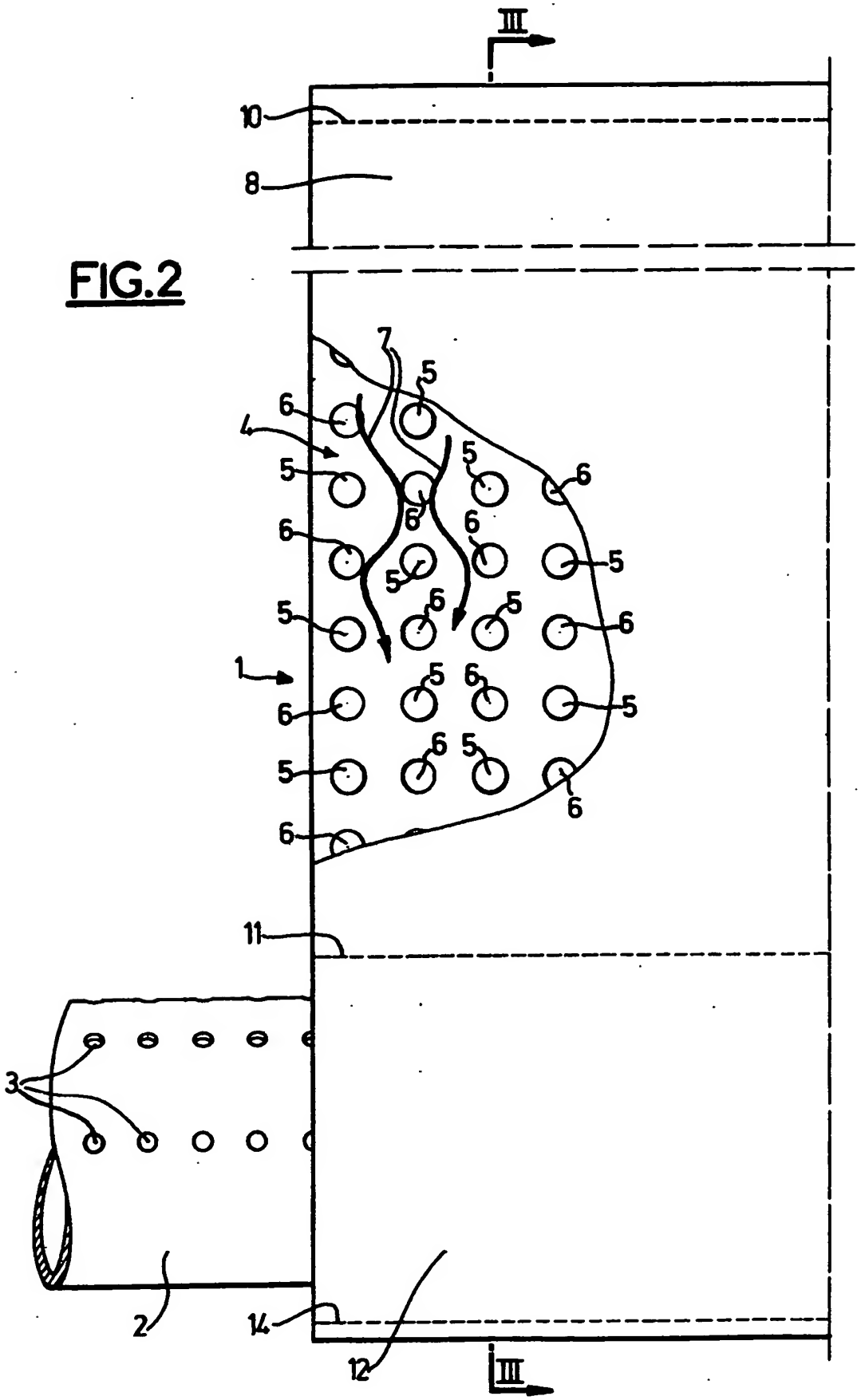

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FIG.3

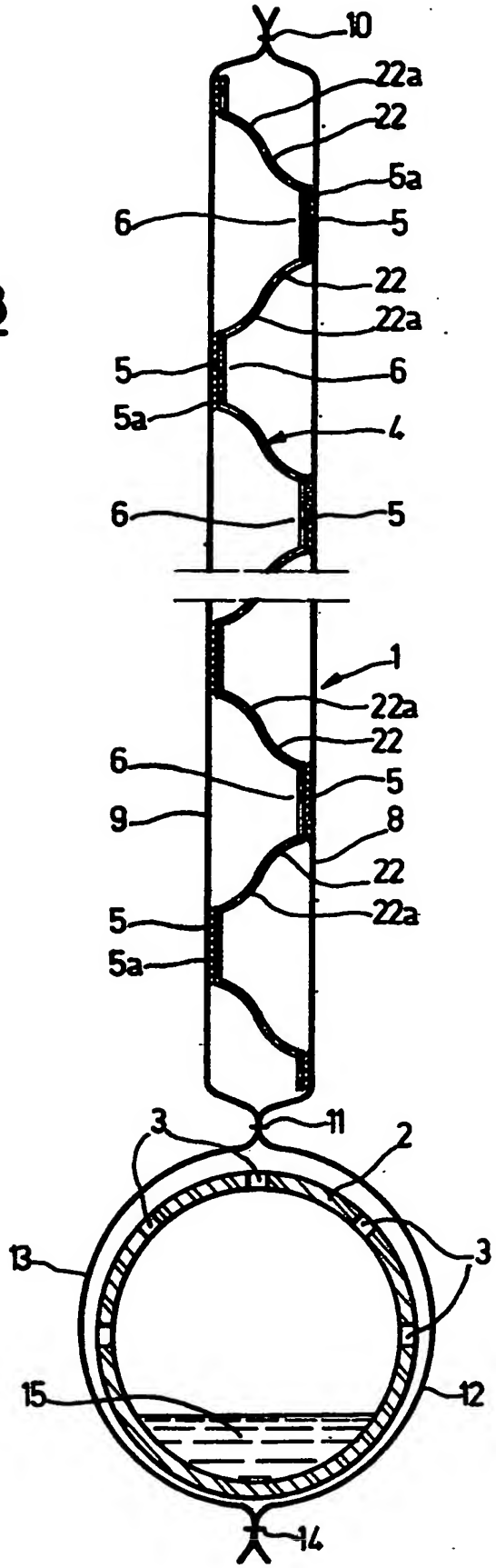

FIG.4

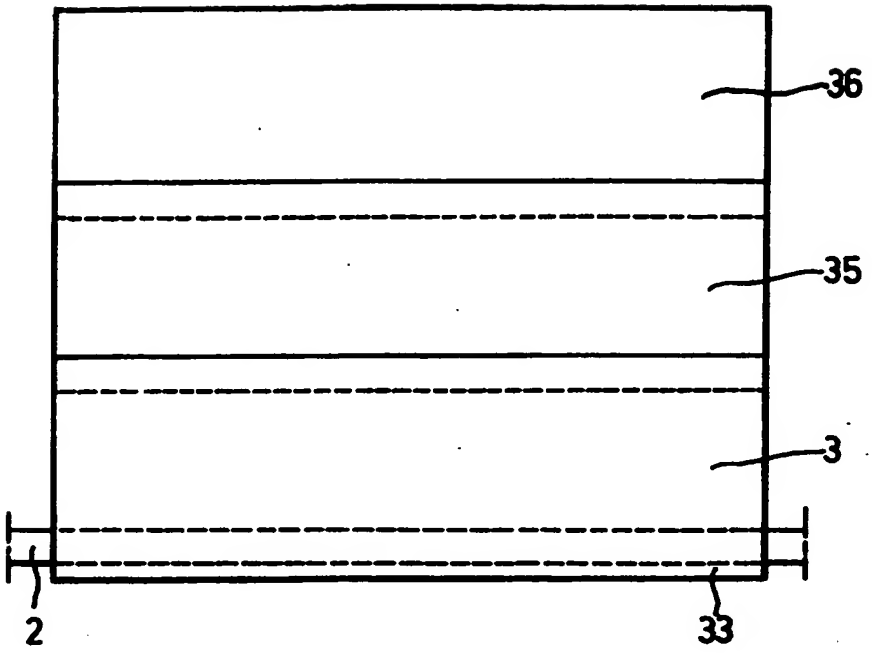

FIG.5

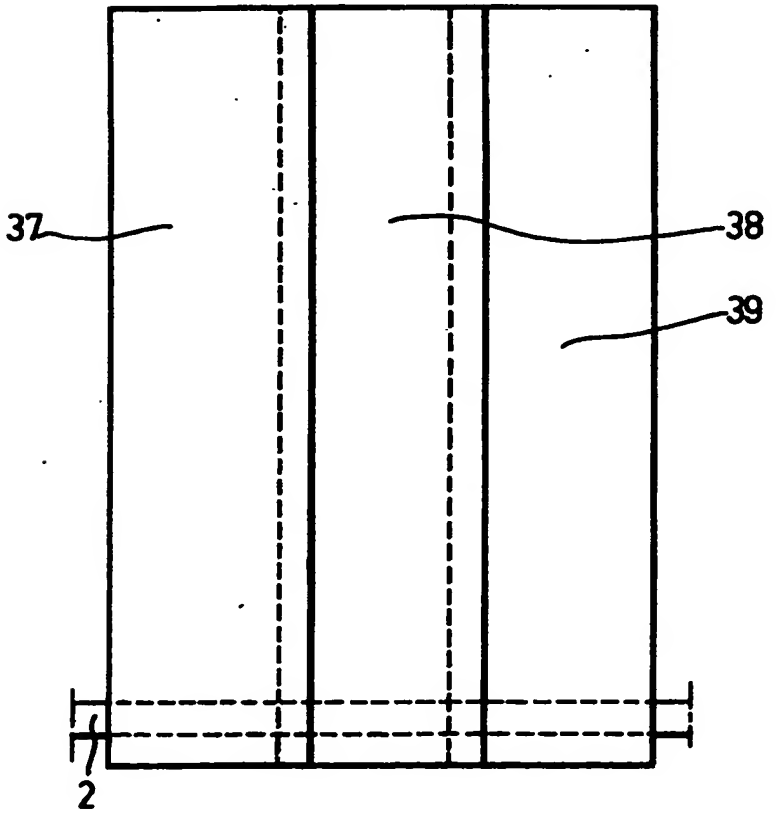

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FIG.6

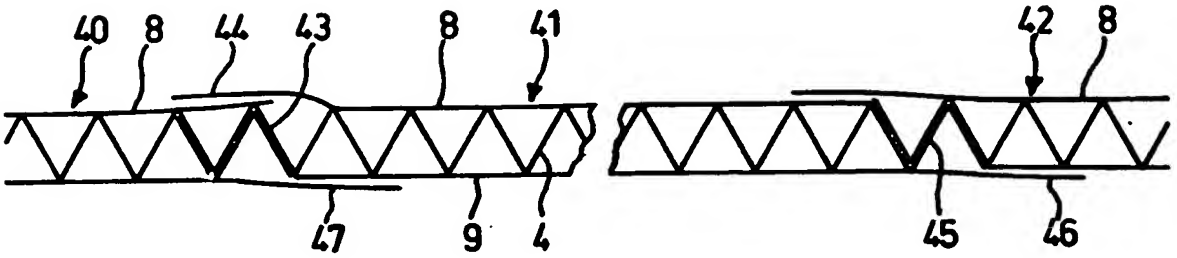
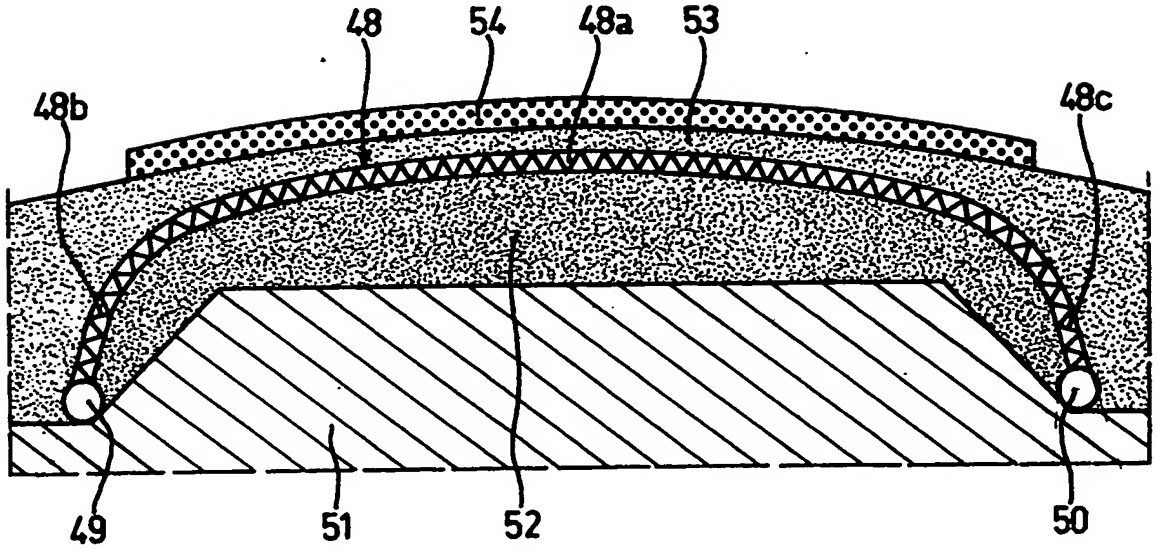


FIG.7



SPECIFICATION

Improvements in or relating to a drain

This invention relates to elements for constructing a drain for use in collecting and discharging water in the ground. It also relates to a method of manufacturing the elements.

In traditional methods of drainage, pipes which are perforated or made of porous material are conventionally disposed at the bottom of a trench and covered with pebbles or loose chippings. The chippings must have a large particle size in order not to clog the drain and thus put the entire drain out of action. The traditional methods, by their very nature, require a large amount of earth to be removed from the excavation and replaced by the aforementioned loose chippings.

To improve these drainage methods, it has already been proposed in U.S. Patent Specification 3,563,038 and 3,654,765 to use previous sheets which act as a filter for the water in the subsoil and which co-operate with a core which can be made of expanded metal or a corrugated plastics component so as to channel the filtered water and convey it towards a drain pipe. The last mentioned drainage device avoids the use and positioning of pebbles or loose chippings as used in traditional drains. As a result, it is no longer necessary to remove and dump the earth from the excavation. The filter is a woven or non-woven textile sheet formed from synthetic fibres and completely surrounding the frame and drain-pipe, resulting in a drainage device which cannot clog and is very light and easy to use.

In spite of these advantages, the device has disadvantages which make it difficult to use in practice, especially when the drainage device has to be placed substantially horizontally e.g. when used for draining a road or track or railway. In such cases, the drainage device is subjected to considerable crushing forces which may damage it.

This invention, therefore, mainly relates to the construction of a material and drainage device which can be used in any position, even if the device has to withstand considerable crushing stress perpendicular to its plane. The invention also relates to a drainage device of the aforementioned kind which is appreciably simpler to manufacture than the known devices and can drain underground water without any risk of clogging, even after a long time, and also can act as a water-tight screen preventing any flow from one side of the drainage device to the other.

According to the invention there is provided a drainage element for use in the drainage of underground water comprising a substantially flat inner core made of waterproof material, both opposed surfaces thereof being covered by respective filter layers, the inner core having a plurality of projections formed in each said surface, and corresponding recesses, and the apexes or tops of which projections on each side of the core being in contact with the respective one of said filter layers thus defining two sets of non-linear channels for the flow of water, each set being on a respective side of said core. Each set of said channels is separated from the other set by the water proof core, so that after the water has travelled through the filter layer, and is thus freed from any fine particles of earth, it is conveyed by gravity along the inner core, and cannot pass through the core and thus cannot escape from the drainage element.

Preferably the projections and corresponding recesses are disposed in staggered rows, which facilitates manufacture and gives an assembly having great compressive strength. Advantageously the filter layers are made up of sheets of woven or non-woven textile based on long synthetic fibres and resistant to the action of any chemical agents conveyed by the underground water. The textile layers can be secured by any suitable method, preferably by sticking, to the tops of the projections on the inner frame. The tops of the projections, which also form the bottom of the corresponding recesses, are preferably substantially flat in order to facilitate the securing process and to improve the compressive strength of the inner frame. It is to be understood that the filter layers need not be stuck to the projections on the core, since in use of the drain, the adjacent earth will keep the filter layers in position.

Preferably one dimension of the core in the plane of the core is less than the corresponding dimension than of the two filter layers, which thus each have a side edge portion which protrudes beyond the inner core.

A drainage device according to the invention, constructed from the aforementioned drainage elements, also comprises at least one drain pipe perforated over part of the surface and peripherally surrounded by said two side edge portions of the two aforementioned filter layers which extend beyond the inner core. The perforated drain pipe can easily be threaded inside the flexible duct formed by the aforementioned two side edge portions, the free edges of which can be suitably joined by any appropriate method. The drain pipe thus collects the water originating from all the channels defined by the core, the water entering the pipe through the perforations. The pipe acts as a discharge pipe.

In a preferred embodiment, the free edges of the two side edge portions adapted to surround the drain pipe are joined by a seam line. The remaining side edges of the two filter layers are preferably interconnected e.g. by seam lines so as completely to surround the inner core.

If the drainage device needs to be large, a number of filter elements can be interconnected. In such a case the inner core of each element has a region covered on one surface by a portion of filter layer which is not secured to the core in that same region, there being no filter layer on the opposed surface of said region other surface, the projections in said region engaging in the recesses in the corresponding region of the core of the

adjacent component. Thus the drainage device can be assembled by fitting together a number of identical components by joining the aforementioned respective portions of each component, which overlap somewhat. The components can be superposed relative to the drain pipe or can be placed side by side, depending on the application.

In an advantageous embodiment, supplementary drainage means are disposed remote from the said drain pipe with respect to the inner core and substantially parallel to said pipe. In use of such an embodiment these additional drainage means are disposed substantially horizontally near the surface of the ground so as to collect water percolating through the ground. The substantially vertical inner core and the lower drain pipe provide drainage and discharge the water as before.

Additional drainage means of this kind may comprise gravel disposed at a certain level of about ten cm. For example, below the surface of the ground. They may also comprise a second drainage pipe which this time is perforated over its entire surface and enclosed by the said filter layers. In use of such an embodiment the second drain pipe is disposed near the surface of the ground and parallel to the first said drain pipe.

The said drain pipe or pipes may be situated approximately in alignment with the plane of the inner core. In an alternative embodiment, the inner core may be extended and come into contact tangentially with the drain pipe, the filter layers enclosing the resulting assembly.

The invention also relates to a method of continuously manufacturing a drainage element or material. In the method the flat sheet of thermoplastic material is heated and conveyed between two calender rollers bearing cylindrical peripheral lugs to form said core, and a textile sheet is then mounted adjacent to the major part of each surface of the resulting cellular continuous strip. Preferably a side portion of the textile sheets on one or both sides of the core extends beyond one or both edges of the core.

Next, if required, the continuous strip of drainage material is finished by forming seam lines so as to join the respective edges of the two textile sheets if required. In a preferred method, the external edges of two side portions of textile sheets are interconnected by a seam line so as to leave a longitudinal pocket for slidingly receiving a drain pipe.

The invention will be more clearly understood from the following detailed description, given by way of example, of a number of embodiments illustrated in the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view of an installation for continuously manufacturing a drainage material or element in accordance to the invention;

FIGURE 2 is a view in elevation, partly cut away, of a first embodiment of a drainage device according to the invention;

FIGURE 3 is a view in section along line III—III of Figure 2;

FIGURE 4 is a diagrammatic view in elevation of another embodiment of a drainage device according to the invention;

FIGURE 5 is a view corresponding to Figure 4, of yet another embodiment of a drainage device according to the invention;

FIGURE 6 is an enlarged diagrammatic view in cross-section of another embodiment of a drainage device in accordance with the invention, showing more particularly the join between the various constituent components, and

FIGURE 7 is a diagrammatic section showing a substantially horizontally-disposed drainage device according to the invention.

Firstly Figures 2 and 3 show an embodiment in which a drainage device according to the invention comprises a drainage material or element (general reference 1) and a drain pipe 2 formed with perforations 3 on the top part of its periphery. The drainage element comprises a substantially flat inner core 4 made of a sheet of suitably thick water proof thermoplastic material. The sheet has a cellular structure made up of a number of substantially frusto conical projections 5 and corresponding recesses 6, which are provided on both sides of the sheet, the projections 5 on one side corresponding to the recesses 6 on the other side and vice-versa. The various projections and recesses have flattened, substantially circular apexes or tops as shown in Figure 2. The surfaces joining a top 5 to an adjacent recess 6, looking at one of the surfaces of core 4, have curved shapes which, as we shall see, result from the process of manufacturing the core.

The various projections 5 are disposed as shown in Figure 2 in staggered rows, thus defining winding non-linear passages shown by arrows 7 in Figure 2, since water always flows from a top 5 to the bottom of a recess 6. The two opposed surfaces of the core 4 are covered by a filter layer 8, 9 respectively, each comprising a non-woven sheet of long synthetic fibres stuck to the substantially flat tops of the external projections 5. In Figure 3, where the thicknesses have been exaggerated for ease of comprehension, the stuck surfaces are denoted by reference 5*a*. Of course, any other method of securing could be used, e.g. thermo-welding or the like. The non-woven material could be replaced by a woven textile, provided that the textile was capable of acting as a filter, i.e. of preventing fine particles of soil flowing through and possibly clogging the drainage device.

Filter sheets 8 and 9 are secured by a seam line 10 at the top of the core 4, Figure 3 and 11 at the bottom, and at both sides of the core thus surrounding completely the inner frame 4. This feature ensures optimum filtering, but in certain applications the top edge of core 4 could be left open by omitting the seam line 10.

The total length of core 4 is less than that of the two filter layers 8, 9 which thus each have on end portions 12, 13, the edges of which are joined by

a seam line 14 so as to define a pocket which can receive a drain pipe 2 as shown in Figures 2 and 3. The dimensions of the pocket are thus chosen so as to be suitably adapted, without excessive tightening, to the outer diameter of drain pipe 2.

When the assembled drainage device has been placed in a trench in ground to be drained, the drain pipe 2 is located either at the bottom of the device, which is substantially vertical, or at the side of the device when it is placed substantially horizontally. The assembly operates as follows. Underground water can enter through the two sides of drainage material 1, either through filter layer 8 or through layer 9, or through supplementary drainage means, such as on bed of gravel or a perforated pipe, provided at the upper end of the core. The water is thus filtered, i.e. the underground water is separated from fine particles of earth. Next, the water flows along each side of core 4 without risk of coming out of the other side of the drainage material, since the plastics sheet forming core 4 is sealing-tight. The thus-collected water flows by gravity into the pocket formed by the end portions 12 and 13, whereupon the water flows through perforations 3 into drain pipe 2. Note that the drain pipe does not have perforations in its lower part and thus forms a sealing-tight drainage channel for discharging the drained water, which is shown at 15 in Figure 3.

The core 4, with its multiple projections disposed in staggered rows, has a cellular structure such that the drainage device can be used in a substantially horizontal position even where it may be subjected to considerable crushing forces. Even in such cases, the special structure of core 4 ensures that the drainage device according to the invention has a long life.

The material or element according to the invention can easily be continuously manufactured in an installation diagrammatically shown in section in Figure 1. A flat thermoplastic sheet 15 is unwound from a reel 17 and then passes through a heating device 18 to increase its malleability, after which the thermoplastic sheet 16 is acted upon by two calender rollers 19, 20 each having a number of peripheral, substantially cylindrical fingers or lugs 21. The lugs are disposed so as to produce the various projections and recesses 5 and 6 shown in staggered lines in Figures 2 and 3. Note the great simplicity of the method of manufacture according to the invention, which is such that the cellular structure shown in Figures 2 and 3 can be formed simply by the use of substantially cylindrical shaping lugs. This is because the ends of lugs 21 deform the thermo-plastic material so that the surfaces adjacent the respective tops of projections 5 are concave 22 as shown in Figure 3, associated with a corresponding convex shape 22*a* of the adjacent recess 6. The inclination of the joining surfaces 22 and 22*a* can be varied by suitably spacing the lugs 21 of the two rollers 19 and 20.

After leaving the calender rollers, the continuous cellular strip 23 travels between two sticking rollers 24 which deposit a suitable adhesive on the flat tops of the projections on the two surfaces of strip 23. Two continuous strips of textile material 25, 26 are unrolled at the same speed as the thermoplastic sheet 16 from reels 27, 28 and are pressed by pressing and sticking rollers 29, 30 against the two surfaces of the continuous cellular strip 23. Various seam lines are formed if required, depending on the applications, in order to finish the material and construct a lateral pocket for receiving a drain pipe as shown in Figures 2 and 3. The resulting material is wound on a reel 31.

The end portions 12, 13 of the material shown in Figures 2 and 3 are made from the continuous textile strips 25, 26 which are wider than strip 23, and which are stuck along all the tops of the projections on its two surfaces.

In most applications, therefore, the drainage material manufactured on the installation diagrammatically shown in Figure 1 will be used so as to produce a drainage device as illustrated in Figures 2 and 3. In some drainage applications, however, it may be necessary to have larger drainage surfaces.

To this end, a drainage device according to the invention can be constructed by joining together a number of individual elements. A first variant is shown in Figure 4. In this embodiment, the drain pipe 2 is disposed adjacent the lower edge of the core of a first drainage element 32. The filtering material sheets associate with the core of the first element 32 are longer than the core 4 and thus have top and bottom portions which extend beyond the core 4. The bottom portions 33 are adapted to define a pocket for accommodating the drain pipe 2. The top portions 34 co-operate with the corresponding bottom portions of the filtering material sheets of a second drainage element 35 identical with element 32. Thus the two top portions 34 overlap with the corresponding bottom portions of the two filtering sheets of element 35. A third element 36 identical with the preceding two elements is connected in the same manner, in that its filtering sheets overlapping that of element 35. The various elements can be interconnected in any appropriate manner, e.g. by seams securing the various respective overlapping portions of the filter sheets of each element. In the present embodiment such securing or seam lines will be parallel to the drain pipe, which is disposed longitudinally.

In another embodiment, shown in Figure 5, the drainage device comprises a drain pipe 2 disposed along the short end of three drainage components 37, 38, 39 which are connected along respective securing or seam lines perpendicular to the axis of drain pipe 2. Side portions of the filtering layers of each drainage element 37 to 39 overlap, so that the filtering layers can be joined together e.g. by seam lines.

In the embodiments illustrated in Figures 4 and 5, the drainage device is preferably disposed substantially vertically and the textile-material side portions of the various elements overlap.

Figure 6 illustrates another method of connecting members made of material in accordance with the invention which can then be used either vertically or when the drainage device is substantially horizontal.

Figure 6 shows schematically three identical components 40, 41, 42 having the structure illustrated in Figures 2 and 3 and inner cores 4 which, to simplify the drawing, are shown in the form of a simple zig-zag. Really, of course, these cores 4 have the same structure as shown in Figures 2 and 3, the filter sheets 8, 9 being secured e.g. by sticking to most of the two surfaces of cores 4 along substantially flat portions of the respective projections, not shown in Figure 6.

In the present embodiment, the drainage material is assembled by joining in an overlapping manner, the edge regions of identical elements 40, 41 and 42. To this end, the edge of core 4 of element 41 has a region 43, the top surface of which is loosely covered by a side portion 44 of the textile sheet 8, which can extend all along the region 43, or, if required, beyond the edge of core 4. This side portion 44 is not stuck to the edge region 43 and is free, as shown in Figure 6. On the other surface of the same region 43, core 4 is free from a textile filter sheet, since the edge of filter sheet 9 stops before region 43.

The adjacent edge of the core 4 of element 41 has a region 45 formed in the opposite manner, i.e. the side portion 46 is not secured by sticking to the textile sheet 9 which is on the inner surface of element 41 relative to Figure 6. By contrast, on the opposite surface of region 45, core 4 is free from a textile sheet, since sheet 8 stops before region 45. Note that the total width of the textile filter sheets 8 and 9 of element 41 is the same and substantially equal to the width of core 4. The filter sheets 8 and 9, however, are secured to the two surfaces of the inner core and are offset from one another in a horizontal plane.

The lateral edges of elements 40, 42 are constructed in the same manner. Consequently, elements 40, 41 and 42 can be joined by engaging the respective sides of two adjacent elements in one another. Thus, the projections in the edge region 43 of element 41 engage in the recesses in the corresponding region of element 40. Such engagement is made possible through the absence of a textile sheet on the bottom surface of the core 4 of element 41 in the aforementioned edge region 43 and the absence of a stuck side portion 44 of the top sheet 8 of element 41. The side portion 44 also covers the filter layer 8 of element 40, whereas the side portion 47 of the bottom sheet 9 of element 40 covers the filter sheet 9 of element 41.

No other securing means are needed between elements 40, 41 and 42, since the soil subsequently cover the assembly and presses the edge regions of the filtering material against one another.

The apparatus shown in Figure 1 can easily be used to join the two filter layers 8, 9 to the core 4 in offset relationship, leaving an edge region free from textile sheet on one surface of the core and comprising a side portion of textile sheet on the other surface and not secured to the core. It is simply necessary to move the set of bottom rollers in the opposite direction from the set of top rollers, so as to stick and unwind the two textile sheets in the correct positions. As a result, simply by moving the sticking rollers 24, the reels 27, 28 and the pressure rollers 29 and 30 relative to one another, the top textile sheet can be moved in one direction and the bottom textile sheet in the other direction relative to the cellular inner core, which remains in its initial position.

Figure 7 diagrammatically shows how the drainage device according to the invention can be used in a substantially horizontal position. The drainage device comprises a drainage material 48 obtained e.g. by joining a number of identical elements as shown in Figure 6. The device also comprises two perforated drain pipes 49, 50 disposed at the sides of a long strip of material, e.g. as illustrated in Figures 2 to 5. A load bearing sub-layer 52 is disposed above the ground 51 and in turn supports the drainage device, most of the material 48 of the drainage device being placed substantially horizontally as at 48*a* and only the side portions connected to the drain pipes 49, 50 being substantially vertical as at 48*b* and 48*c*.

The drainage device is covered with a top load bearing layer 53 covered by a surface 54 for producing e.g. a road or motorway. The drainage material 48 prevents water rising from the ground 51 through the bottom load bearing sub-layer 52, e.g. as a result of pressure exerted by passing vehicles on road 54. If road 54 is porous, the drainage material 48 prevents water from passing from the top sub-layer 53 to the bottom sub-layer 52, thus preventing the road foundation from deteriorating. Drainage water collected by material 48 flows through the substantially vertical portions 48*b*, 48*c* towards the two drain pipes 49, 50, through which it is discharged.

The thickness of the thermoplastic substance forming the inner core of the material according to the invention, like the thickness of the textile filter sheets, can be chosen in dependence on the application for which is intended.

The drainage material according to the invention can be used to construct drainage devices for use on all occasions where traditional methods of horizontal or vertical drainage are conventionally employed, whenever water from the ground can be collected or discharged by gravity.

CLAIMS

1. A drainage element for use in the drainage of underground water comprising a substantially flat inner core made of waterproof material, both opposed surfaces thereof being covered by respective filter layers, the inner core having a plurality of projections formed in each said surface, and corresponding recesses, and the apexes or tops of which projections on each side

of the core being in contact with the respective one of said filter layers thus defining two sets of non-linear channels for the flow of water, each set being on a respective side of said core.

2. An element according to claim 1, wherein the projections are disposed in staggered rows.

3. An element according to claim 1 or 2, wherein the filter layers are made of woven or non-woven long-fibre synthetic textile material.

4. An element according to any of the preceding claims, wherein the filter layers are secured to the projections on the inner core.

5. An element according to claim 4 wherein the filter layers are secured to the projections by sticking.

6. A material according to any of the preceding claims, wherein the projections each have a substantially flat top portion.

7. A drainage element according to any of the preceding claims, wherein one dimension of the core in the plane of the core is less than the corresponding dimension of the two filter layers, which thus each have a side edge portion which protrudes beyond the inner core.

8. A drainage element according to claim 7, in combination with at least one identical element, the elements having overlapping side portions which are joined together.

9. A drainage element according to claim 8, wherein the inner core of each element has a region covered on one surface by a side portion of filter layer which is not secured to the core in that same region, there being no filter layer on the opposed surface of said regions other surface, the projections in said region engaging in the recess in the corresponding region of the core of the adjacent component.

10. A drainage device comprising a drainage element according to claim 7, combined with a drain pipe perforated over part of its structure and peripherally surrounded by said two side edge portions of the aforementioned filter layers, which extend beyond the inner core.

11. A drainage device according to claim 10, wherein an additional drainage means comprising gravel or a second perforated pipe are disposed in communication with the channels defined by the core at a position remote from the first drain pipe.

12. A drainage device according to claim 10 or 11, wherein the or each drain pipe is disposed in alignment with the plane of the inner core.

13. A drainage device according to claim 10 or 11, wherein the inner core extends tangentially to contact the or each drain pipe, the filter layers enclosing the device.

14. A drainage device according to any one of claims 10 to 13 wherein the two edges of the two side edge portions of the filter layers surrounding the drain pipe are interconnected.

15. A drainage device according to claim 14 wherein the side edge portions are interconnected by a seam.

16. A drainage device according to any one of claims 10 to 15 wherein the edges of the two filter layers are connected by a seam so as to surround the inner core.

17. A drainage device according to any one of claims 10 to 16, comprising a plurality of elements, the filter layer of each of which has at least one side portion at the edge of the core projecting therefrom, the device being made up of a number of drainage elements, joined by the aforementioned respective side portions.

18. A drainage device according to claim 17, wherein the various components overlap and are joined along lines substantially parallel to the drain pipe.

19. A drainage device according to claim 17, wherein the various components overlap and are joined along lines substantially perpendicular to the drain pipe.

20. A method of continuously manufacturing a drainage element according to any of claims 1 to 7, wherein a flat sheet of thermoplastic material is heated and conveyed between two calender, rollers bearing cylindrical peripheral lugs to form said core and a textile sheet is then mounted adjacent to the major part of each surface of the resulting cellular continuous strip.

21. A method according to claim 20 wherein, a side portion of at least one the aforementioned textile sheets extend beyond at least one of the sides of the core.

22. A method according to claim 20 or 21 wherein the edges of the textile sheets are connected by a seam line.

23. A method according to claim 21, wherein in a region at one side edge of the core, one surface of the region bears a portion of textile sheet extending beyond the core and not secured to the core in the aforementioned region, whereas the other surface of the region is not covered by a textile sheet.

24. A method according to claim 23, wherein top and bottom rollers, which carry the textile sheets so as to stick them to the inner core are movable in opposite directions to adjust the positions at which the textile sheets are mounted on the core.

25. A drainage element substantially as herein described with reference to and as shown in the accompanying drawings.

26. A drainage device substantially as herein described with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

27. A drainage device substantially as herein described with reference to and as shown in Figure 4 of the accompanying drawings.

28. A drainage device substantially as herein described with reference to and as shown in Figure 5 of the accompanying drawings.

29. A drainage device substantially as herein described with reference to and as shown in Figures 6 and 7 of the accompanying drawings.

30. A method of manufacturing a drainage element substantially as herein described with reference to Figure 1 of the accompanying drawings.

31. Any novel feature or combination of features disclosed herein.

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